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National Eutrophication Survey, Las Vegas, Nev

Prepared for

Environmental Monitoring and Support Lab, Las Vegas, Nev

Mar 77

PB 269 476

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NATIONAL EUTROPHICATION SURVEY
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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT

ON

BLACK BAYOU RESERVOIR

CADDO PARISH

LOUISIANA

EPA REGION VI

WORKING PAPER No. 550

WITH THE COOPERATION OF THE

LOUISIANA WILD LIFE AND FISHERIES COMMISSION

AND THE

LOUISIANA NATIONAL GUARD

MARCH, 1977

REPORT ON BLACK BAYOU RESERVOIR

CADDO PARISH, LOUISIANA

EPA REGION VI

by

National Eutrophication Survey

Water and Land Monitoring Branch
Monitoring Applications Laboratory
Environmental Monitoring & Support Laboratory
Las Vegas, Nevada

and

Eutrophication Survey Branch
Corvallis Environmental Research Laboratory
Corvallis, Oregon

Working Paper No. 530

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY

March 1977

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §309(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by the U.S. Environmental Protection Agency and to augment plans implementation by the states.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Louisiana Wild Life and Fisheries Commission, Division of Water Pollution Control for professional involvement, to the Louisiana National Guard for conducting the tributary sampling phase of the Survey, and to those Louisiana wastewater treatment plant operators who provided effluent samples and flow data.

Robert A. Lafleur, Chief; J. Dale Givens, Assistant Chief; Lewis P. Still, Biologist; Louis Johnson, Biologist; Lee Caubarreaux, Biologist; Darrell Reed, Engineer; Dempsey Alford, Biologist; and Elwood Goodwin, Water Quality Control Technician, all of the Louisiana Wild Life and Fisheries Commission, Division of Water Pollution Control reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper Series.

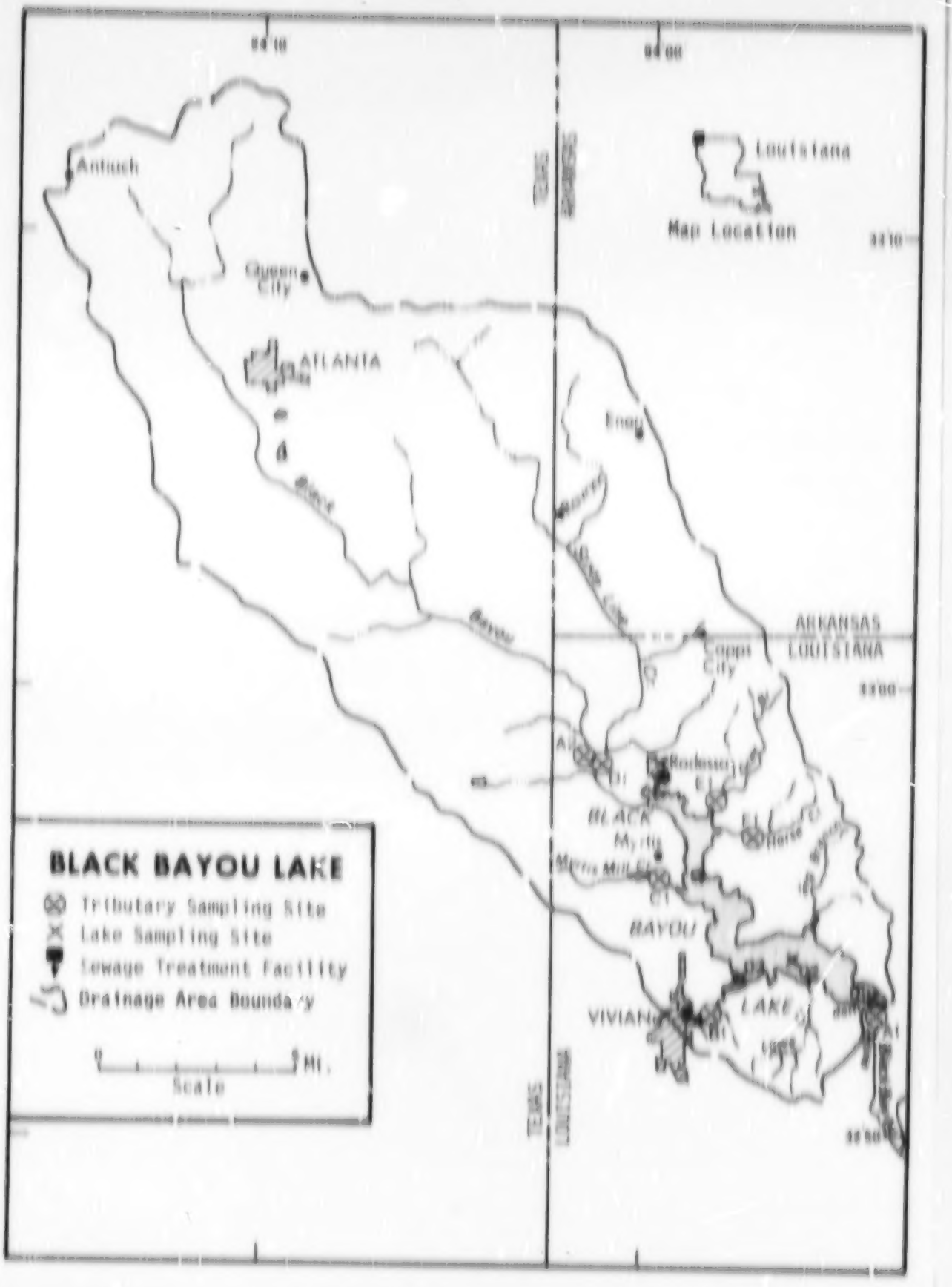
Major General O'Neil Daigle, Jr., the Adjutant General of Louisiana, and Project Officer Colonel Lawrence F. Dupre, who directed the volunteer efforts of the Louisiana National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF LOUISIANA

LAKE NAME	PARISH
Anacoco Lake	Vernon
Lake Bistineau	Bienville, Webster
Black Bayou	Caddo
Black Lake	Natchitoches and Red River
Bruin Lake	Tensas
Bundicks Lake	Beauregard
Caddo Lake	Caddo (Menon and Harrison in Texas)
Cocodrie Lake	Concordia
Cocodrie Lake (Lower)	Rapides
Concordia Lake	Concordia
Cotile Lake	Rapides
Cross Lake	Caddo
D'Arbonne Lake	Union
False River Lake	Pointe Coupee
Indian Creek Reservoir	Rapides
Saline Lake	LaSalle
Turkey Creek Lake	Franklin
Lake Vernon	Vernon
Lake Verret	Assumption


Louisiana
Map Location
Antioch
Queen City
ATLANTA
Emory
ARKANSAS
LOUISIANA
Cooper City
Red River
BLACK
BAYOU
VIVIAN
LAKE
BLACK BAYOU LAKE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Drainage Area Boundary
0
3 Mi.
Scale

REPORT ON BLACK BAYOU RESERVOIR, LOUISIANA
STORET NO. 2204

I. CONCLUSIONS

A. Trophic Condition*

On the basis of survey data and field observations, Black Bayou Reservoir is considered eutrophic, i.e., nutrient rich and highly productive. Whether such nutrient enrichment is to be considered beneficial or deleterious is determined by its actual or potential impact upon designated beneficial water uses of each lake.

Chlorophyll a levels ranged from 2.8 ug/l in the fall to 47.0 ug/l in August with a mean of 17.8 ug/l. Potential for primary production as measured by algal assay control yield was high, and Secchi disc transparency was low. Of the 19 Louisiana lakes sampled in 1974, 13 had greater median total phosphorus, 13 had greater median inorganic nitrogen, and 15 had greater median orthophosphorus levels than Black Bayou Reservoir.

Field limnologists reported abundant aquatic macrophytes along the lake bottom and shoreline area. Other studies (Shampine, 1971) indicate that past pollution to Black Bayou Reservoir from oil field wastes appears to have presently been curtailed. The general water quality

*See Appendix E.

in Black Bayou Reservoir appears to range widely, both with respect to areas within the lake and the time of year.

B. Rate-Limiting Nutrient:

Mean inorganic nitrogen to orthophosphorus ratios (N/P) for the reservoir were 9/1 or less on all four sampling occasions suggesting primary limitation by nitrogen.

C. Nutrient Controllability:

1. Point sources -

The mean annual phosphorus load from point sources was estimated to be approximately 18.4% of the total load reaching Black Bayou Reservoir. The city of Vivian contributed this entire point source load.

The phosphorus loading of 1.07 g $P/m^2/yr$ for Black Bayou Reservoir is approximately 1.6 times the "eutrophic" load proposed by Vollenweider (1975) for lakes with such volume and detention time. Although elimination of the Vivian point source contributions would substantially reduce loading to the lake, concurrent control of nonpoint sources in the Black Bayou watershed is probably necessary to effect significant water quality improvement.

2. Nonpoint sources -

The mean annual phosphorus load from nonpoint sources was estimated to be 81.6% of the total load. Measured tributaries accounted for 62.5% of the total, and ungaged tributaries were estimated to account for 17.3%.

In general, few lakes are nitrogen limited as a result of low nitrogen. Rather, excessive phosphorus levels shift limitations to nitrogen or other factors. Regardless of the primary nutrient limitation suggested by either algal assay or nutrient ratios, the most feasible approach to nutrient control, if desirable, is through available phosphorus control technology and subsequent establishment of phosphorus limitation within the water body.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. Lake surface area and mean depth were provided by the State of Louisiana; maximum depth was obtained from contour maps provided by the Louisiana Stream Control Commission; tributary flow data were provided by the Louisiana District Office of the U.S. Geological Survey (USGS)(outlet drainage area includes the lake surface area). Mean hydraulic retention time was obtained by dividing the lake volume by mean flow of the outlet. Precipitation values are estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No. 175. A table of metric/English conversions is included as Appendix A.

A. Lake Morphometry:

1. Surface area: 16.06 km^2.
2. Mean depth: 1.4 meters.
3. Maximum depth: 2.4 meters.
4. Volume: 21.956 x 10^6 m^3.
5. Mean hydraulic retention time: 37 days.

B. Tributary and Outlet (see Appendix B for flow data):

1. Tributaries -

Name	Drainage area(km^2)	Mean flow (m^3/sec)
A-2 Black Bayou	298.3	3.37
B-1 State Line Creek	139.6	1.69
E-1 Gray Branch	16.8	0.16
Minor tributaries and immediate drainage -	141.9	1.80
Totals	593.0	6.94
2. Outlet - A-1 Black Bayou	609.6	6.94

C. Precipitation:

1. Year of sampling: 154.3 cm.

2. Mean annual: 117.8 cm.

III. LAKE WATER QUALITY SUMMARY

Black Bayou Reservoir was sampled four times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from one or more depths at each station (see map, page v). During each visit, depth-integrated samples were collected from each station for chlorophyll a analysis and phytoplankton identification and enumeration. During the first and last visits, 18.9-liter depth-integrated samples were composited for algal assays. Maximum depths sampled were 1.8 meters at Station 01, 2.4 meters at Station 02, and 1.5 meters at Station 03. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix C and are summarized in III-A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll a determinations are included in III-B. Results of the limiting nutrient study are presented in III-C.

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B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera		Algal Units per ml
03/27/74	1.	Dactylococcopsis	611
	2.	Cryptomonas	500
	3.	Dinobryon	446
	4.	Flagellates	445
	5.	Oscillatoria	222
		Other genera	223
		Total	2,446
06/03/74	1.	Asterionella	4,802
	2.	Aphanothece	2,036
	3.	Flagellates	1,200
	4.	Ankistrodesmus	626
	5.	Melosira	418
		Other genera	1,982
		Total	11,064
08/26/74	1.	Centric diatom	2,007
	2.	Ankistrodesmus	618
	3.	Lyngbya	618
	4.	Anabaena	463
	5.	Cryptomonas	106
		Other genera	2,973
		Total	7,065
11/11/74	1.	Cryptomonas	220
	2.	Dactylococcopsis	147
	3.	Euglena	110
	4.	Oscillatoria	37
	5.	Phacus	37
		Other genera	---
		Total	551

B. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (ug/l)
03/23/74	01	6.0
	02	5.3
	03	15.0
06/03/74	01	24.1
	02	32.1
	03	23.3
08/26/74	01	23.3
	02	14.5
	03	47.0
11/11/74	01	4.6
	02	7.8
	03	---

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked - (03/23/74)

Spike(mg/l)	Ortho P Conc.(mg/l)	Inorganic N Conc.(mg/l)	Maximum Yield (mg/l-dry wt.)
Control	0.060	0.174	4.1
0.05 P	0.115	0.174	4.1
0.05 P + 1.0 N	0.115	1.174	82.0
1.00 N	0.065	1.174	16.6

2. Discussion -

The control yield of the assay alga, Selenastrum capricarnutum, indicates that the potential for primary production in Black Bayou Reservoir was high at the time of spring assay sample collection. Growth response with the addition of nitrogen as well as the lack of response to the addition of phosphorus indicates nitrogen limitation. Maximum growth yield was achieved with the simultaneous addition of both phosphorus and nitrogen.

It should be noted that significant chemical changes took place in Louisiana lake samples between collection and algal assay. The assay data should be considered in this context and until such differences are resolved, used with caution for any prediction of actual lake conditions. Such chemical changes are likely to alter the control yield as well as modifying the N/P ratio.

The autumn algal assay results have not been included as the substantial changes in nutrient levels have removed their information value.

The mean N/P ratios for Black Bayou Reservoir of 9/1 or less on all four sampling occasions suggest primary limitation by nitrogen (an N/P ratio of 14/1 or greater generally reflects phosphorus limitation).

IV. NUTRIENT LOADINGS
(See Appendix B for data)

For the determination of nutrient loadings, the Louisiana National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of February, March, and April when two samples were collected. Sampling was begun in June 1974 and was completed in April 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Louisiana District Office of the USGS for the tributary sites nearest the lake.

In this report, nutrients loads for sampled tributaries were determined by using a modification of a USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual nutrient loads, in kg/km^2/yr, for Black Bayou, State Line Creek, and Gray Branch, at Stations A-2, D-1, and E-1, respectively, and multiplying the means by the ZZ area in km^2.

The operator of the Vivian wastewater treatment plant provided monthly effluent samples and corresponding flow data.

A. Waste Sources:

1. Known municipal -

Name	Population Served*	Treatment	Mean Flow ($m^3/d \times 10^3$)	Receiving Water
Vivian	6,000	Trickling Filter	1.751	Unnamed Stream

2. Known industrial - None

*U.S. EPA, 1971.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (nonpoint load)		
A-2 Black Bayou	6,865	39.9
B-1 State Line Creek	3,665	21.3
E-1 Gray Branch	220	1.3
b. Minor tributaries and immediate drainage (nonpoint load) -	2,980	17.3
c. Known municipal STP's -		
Vivian	3,175	18.4
d. Septic tanks* -	30	0.2
e. Known industrial - none		
f. Direct precipitation** -	200	1.6
Totals	17,215	100.0
2. Outputs - A-1 Black Bayou	7,985	
3. Net annual P accumulation	9,230	

*Estimate based on 105 lakeshore residences.
**Estimated (see NES Working Paper No. 175).

E. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (nonpoint load) -		
A-2 Black Bayou	30,490	41.9
D-1 State Line Creek	47,685	22.1
F-1 Gray Branch	5,030	2.3
b. Minor tributaries and immediate drainage (nonpoint load) -	45,265	21.0
c. Known municipal STP's -		
Vivian	9,175	4.2
d. Septic tanks* -	1,120	0.5
e. Known industrial - none		
f. Direct precipitation** -	17,340	8.0
Totals	216,104	100.0
2. Outputs - A-1 Black Bayou	170,090	
3. Net annual N accumulation -	46,015	

*Estimate based on 105 lakeshore residences.
**Estimated (see NES Working Paper No. 175).

D. Mean Annual Nonpoint Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Black Bayou	23	306
State Line Creek	26	342
Gray Branch	14	310

F. Mean Nutrient Concentrations in Ungaged Streams:

Tributary	Mean Total P (mg/l)	Mean Total N (mg/l)
B-1 Unnamed Stream	3.702	12.467
C-1 Myrtis Mill Creek	0.074	1.035
F-1 Horse Creek	0.037	0.692

The nutrient levels in tributaries C-1 and F-1 were in line with the measurements in the gaged streams entering Black Bayou Reservoir. However, nutrient levels for Unnamed Stream, B-1, were excessively high. This is probably attributable to the proximity of the tributary sampling station to the Vivian municipal sewage treatment plant outfall.

f. Yearly Loadings:

In the following table, the existing phosphorus annual loading is compared to the relationship proposed by Vollenweider (1975). Essentially, his "eutrophic" loading is that at which the receiving waters would become eutrophic or remain eutrophic; his "oligotrophic" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A "mesotrophic" loading would be considered one between "eutrophic" and "oligotrophic".

Note that Vollenweider's model may not apply to lakes with short hydraulic retention times or in which light penetration is severely restricted by high concentrations of suspended solids in the surface waters.

	Total Yearly Phosphorus Loading ($g/m^2/yr$)
Estimated loading for Black Bayou Reservoir	1.07
Vollenweider's "eutrophic" loading	0.33
Vollenweider's "oligotrophic" loading	0.67

V. LITERATURE R VIEWED

Shampine, W. J. 1971. Chemical, Biological, and Physical Data for the Major Lakes and Reservoirs in Louisiana. Louisiana Department of Public Works, #5 Baton Rouge, Louisiana.

U.S. Environmental Protection Agency. 1971. A 1968 Inventory of Municipal Waste Facilities. EPA Publication No. OWP-1, Vol. 6, U.S. Government Printing Office, Washington, DC.

_____. 1975. National Eutrophication Survey Methods 1973-1976. Working Paper No. 175. Environmental Monitoring and Support Laboratory, Las Vegas, Nevada and Corvallis Environmental Research Laboratory, Corvallis, Oregon.

Vollenweider, R. A. 1975. Input-Output Models With Special Reference to the Phosphorus Loading Concept in Limnology. Schweiz. Z. Hydrol. 37:53-84.

V. APPENDICES

APPENDIX A
CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Meters x 3.281 = feet

Cubic meters x 8.107 x 10^{-4} = acre feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX B

TRIBUTARY FLOW DATA

[illegible]

APPENDIX C
PHYSICAL AND CHEMICAL DATA

[illegible]

APPENDIX D

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

[illegible]

DATE	TIME	DEPTH	TOTAL NITRATE	DISS. ORTHO PHOSPHATE	SILICATE	DISS. OXYGEN	DISSOLVED OXYGEN
FROM	TO		NITRITE	N	TOTAL	[illegible]	
'72	[illegible]	METRES	MG/L	MG/L	MG/L	MG/L +	MG/L +
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7w98w9n	33	47	1.021	6.448	1.039	7.421	2.825
7w97f9n	69	93	0.249	6.995	1.096	7.325	0.878
7w6m73	17	19	1.825	6.786	1.035	1.475	0.943
7w89w87	87	95	1.044	6.268	1.027	1.815	0.838
7w732f5	11	18	1.25-	5.939	1.035	1.234	0.822
7w736f1-	13	15	.25--	1.477	1.037	1.813	1.425
7w7.1f84	84	85	1.884	8.471	1.096	1.428	0.838
7w732f87	68	93	1.811	8.968	1.045	1.818	0.823
75f81f11	84	89	0.814	6.756	1.034	1.815	0.829
75f87f89	11	15	1.424	6.998	0.832	1.889	0.835
75f32f27	94	95	0.846	6.481	1.049	1.432	0.895
75f23f87	84	91	1.731	8.549	1.831	1.889	0.845
75f83f27	69	75	0.811	8.858	0.822	1.884	0.838
75f84f85	89	98	0.814	8.958	1.835	1.819	0.825
75f84f15	84	95	1.814		1.846	1.436	

APPENDIX E

PARAMETRIC RANKINGS OF LAKES SAMPLED BY NES IN 1973

STATE OF

LOUISIANA

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	[illegible] TOTAL P	[illegible] DOMPS N	[illegible] [illegible] SEC	[illegible] CHLORA	[illegible] [illegible]	[illegible] [illegible] DISS ORTHO P	SI
2001	[illegible] LAKE	42 (140)	43 (144)	67 (123)	44 (154)	63 (154)	94 (271)	
2002	[illegible] LAKE	61 (140)	11 (23)	63 (154)	61 (111)	3 (8)	58 (93)	
2003	LAKE [illegible]	94 (90)	58 (40)	41 (111)	72 (139)	42 (74)	33 (43)	
2004	[illegible] [illegible]	72 (139)	72 (139)	78 (144)	56 (111)	58 (90)	81 (144)	
2005	[illegible] LAKE	11 (39)	33 (93)	33 (93)	44 (85)	78 (144)	8 (8)	
2007	[illegible] LAKE	28 (58)	8 (8)	11 (23)	11 (23)	158 (288)	17 (35)	
2008	[illegible] LAKE	83 (153)	58 (90)	94 (271)	83 (154)	33 (60)	61 (111)	
2009	[illegible] LAKE	44 (83)	83 (144)	36 (73)	22 (47)	14 (23)	61 (111)	
2010	[illegible] LAKE	94 (139)	43 (144)	28 (58)	6 (11)	72 (139)	69 (139)	
2011	[illegible] LAKE	78 (144)	58 (90)	58 (139)	94 (171)	42 (73)	58 (108)	
2012	FALSE [illegible] LAKE	33 (61)	39 (73)	89 (169)	28 (58)	6 (11)	28 (58)	
2013	[illegible] CREEK	42 (139)	28 (58)	58 (90)	39 (73)	14 (23)	69 (139)	
2014	SALINE LAKE	17 (39)	6 (11)	8 (8)	67 (123)	94 (171)	22 (43)	
2015	TURKEY CREEK LAKE	8 (8)	17 (39)	22 (43)	33 (61)	22 (43)	11 (23)	
2016	LAKE [illegible]	6 (11)	58 (90)	6 (11)	5 (8)	94 (139)	6 (11)	
2017	LAKE [illegible]	139 (288)	44 (83)	168 (288)	108 (288)	28 (58)	288 (288)	
2019	BLACK LAKE	39 (73)	22 (43)	72 (139)	78 (144)	67 (123)	39 (73)	
2020	[illegible]	23 (43)	108 (288)	17 (39)	17 (39)	93 (233)	44 (83)	
4007	CADDO LAKE	67 (123)	94 (171)	44 (83)	58 (90)	88 (288)	87 (144)	